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S7001 USER'S GUIDE

Version 1.0

STATIC ANALYSIS OF FRAMED STRUCTURES

by

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PREFACE

The information contained in this report is technical in nature. It does not contain policy of the Naval Civil Engineering Laboratory, the Naval Facilities Engineering Command, the Assistant Commander of Engineering and Design, or the Director of Engineering System Division. This report is one of a series which is designed to provide technical information and documentation for studies conducted in support of the Naval Facilities Engineering Command Graphics Engineering and Mapping Systems, Engineering Microcomputer Graphics, Computer-Aided Design, Cost Engineering System, and Guide Specifications System as they relate to the Naval Facilities System and life cycle facilities management.

CONTENTS

INTRODUCTION

The S7001 general purpose frame analysis computer program can be used to statically analyze continuous beams, plane truss, plane frame, grids, space truss, and space frame structures that are composed of prismatic elastic members.

CAPABILITIES

S7001 computes all joint displacements in the X, Y, and Z directions. S7001 also computes all of the structural members' end reactions based on the member properties, structural geometry, and loading conditions.

S7001 handles loads located anywhere on the structure, including the joints. The loads can be concentrated joint loads, forces and moments, and concentrated and uniformly distributed loads on the members. However, for the load on the members the user is required to compute the equivalent fixed end loads. The user can also specify an indefinite number of load cases.

The structures to be analyzed have a maximum size limitation of 30 joints for a space frame; 60 joints for a space truss, grid, and plane frame; and 90 joints for plane truss and continuous beams.

The program doesn't account for the effects of temperature, support displacements, inclined roller support surfaces, elastic supports, non-prismatic members, or elastic connections.

Nonprismatic members may be analyzed by dividing them into several smaller member segments, joined end to end by a series of fixed joints. These smaller members are then assigned individual moments of inertia to simulate the actual varying moment of inertia. Curved members may also be simulated by dividing the members into a series of straight line segments, connected by rigid joints.

SOLUTION METHODS

The S7001 program performs a static analysis utilizing the stiffness method discussed in Reference 1. It is assumed that the new user is thoroughly familiar with the stiffness method.

PROBLEM DATA PREPARATION INSTRUCTIONS

1. Sketch the structure to be analyzed and choose a starting member. Number the members consecutively, starting with the number one. Number the joint in a consecutive manner keeping the joint numbers at the member ends as close as possible to reduce the bandwidth of the stiffness matrix.

2. Indicate the number of all possible degrees of restraint for each support joint; up to 6 for a space frame; up to 3 for a space truss, grid, or plane frame; and up to 2 for a plane truss or continuous beam.

3. Choose a reference origin point in order to assign member end coordinates and X, Y, Z coordinate distances to every joint in the structure. The choice of this reference origin point is entirely arbitrary.

4. Use the sign conventions that are illustrated in Figure 1. For moment signs, use the standard right-hand rule. For example, when the right-hand thumb points in the positive X direction, the fingers point in the positive direction of M_x. Signs for M_y and M_z are determined similarly.

5. Make sure the input data share a consistent system of units which include force, length, and material properties. The calculation results will have the same units as the input data and all angles will automatically be in radians.

6. Make sure member loads are transformed to equivalent joint loads by assuming the ends of the member fixed and calculating the fixed end reactions. The fixed end reactions must be resolved into the member axis (local) coordinate system. This computation must be performed by the user.

7. Right justify all integer values. This can be easily accomplished by using a word processing or screen editor program with a right-hand tab feature. However, an ASCII file without control characters must be created.

DEFINITIONS FOR DATA AND FORMAT TABLES

Use the following data and format tables as guides to input the problem data necessary to analyze each structure type. In the following data format tables the symbols defined below are used:

AX	Cross sectional area
IX	Torsion constant
IY	Moment of inertia about the y axis
IZ	Moment of inertia about the z axis
L	Length of member
I end	The first joint referenced when defining the member connectivity in the "Member Data" section (the I reference).
J end	The second member joint (the J reference).

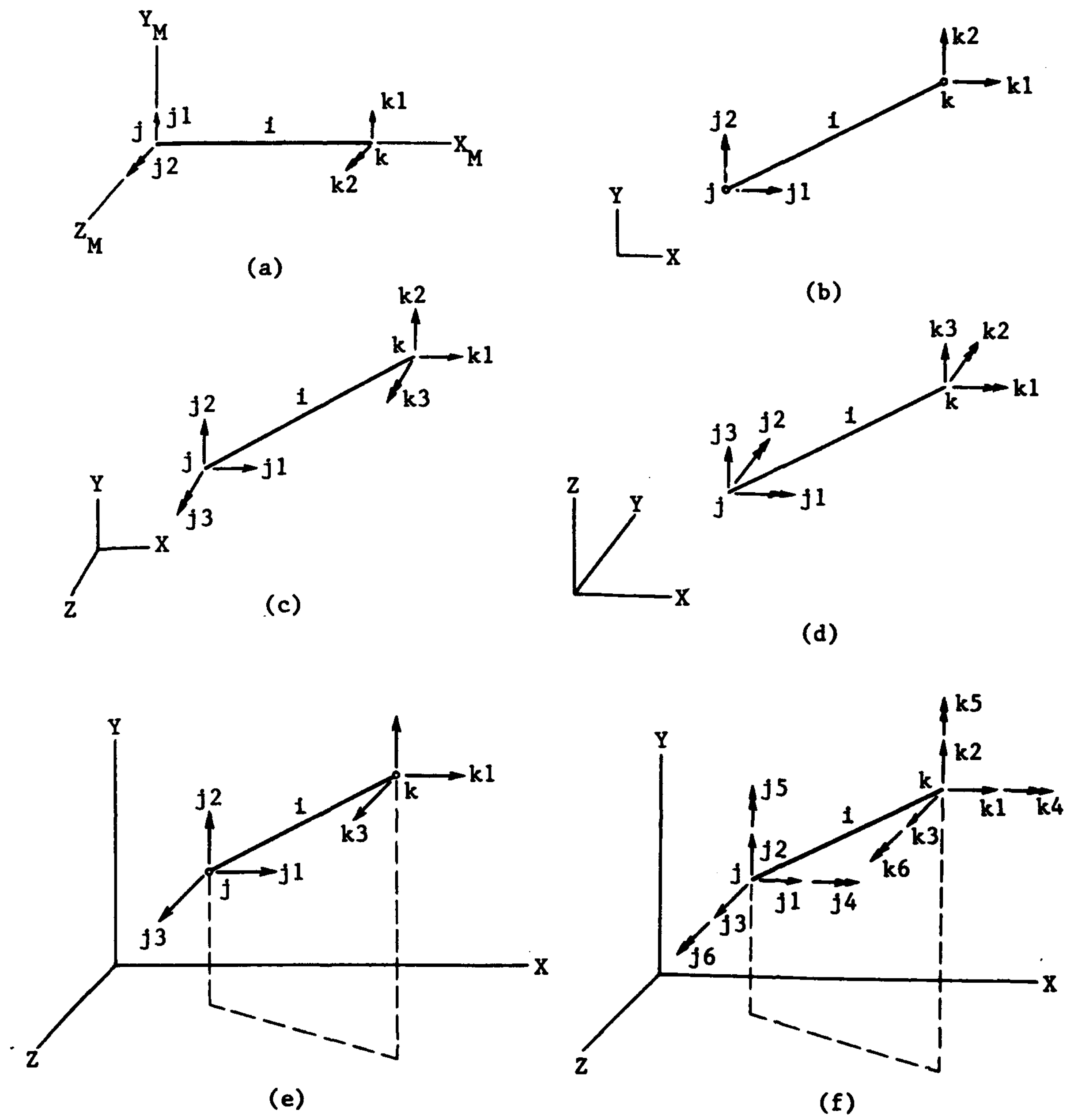


Figure 1. Structure (global) axis system sign conventions for individual members: (a) continuous beam member; (b) plane truss member; (c) plane frame member; (d) grid member; (e) space truss member; (f) space frame member.

General Data

Problem Identification Data - Line Type A:

Columns	Variable	Entry
1-70	TITLE	Problem title or identification

Analysis Control - Line Type B:

Columns	Variable	Entry
1-5	TS	1 - For continuous beam 2 - For plane truss 3 - For plane frame 4 - For grid frame 5 - For space truss 6 - For space frame
6-10	NLS	Number of load cases to be analyzed

Structure Type Dependent Data

Different data is required for each individual structure type. Therefore, the following sections specify the necessary data for each structure type. The data preparation instructions for each of the six structure types listed on the Analysis Control Line (Type B), begin at the top of a page to make it easier to locate the desired type.

Continuous Beam Data. The continuous beam data includes Line Types A and B plus the following lines.

Continuous Beam Problem Control - Line Type C:

Columns	Variable	Entry
1-5	NM	Total number of members
6-10	NR	Number of support restraints (total number of support reactions)
11-15	NRJ	Number of restrained joints (total number of supports)
16-25	E	Modulus of elasticity (for all members)

Line Type D (omitted)

Continuous Beam Member Table - Line Type E (Repeated NM Times):

Columns	Variable	Entry
1-5	I	Member number
6-15	L	Length of member
16-25	IZ(I)	Moment of inertia about the Z axis

Line Type F (omitted)

Continuous Beam Joint Restraint Table - Line Type G Repeated NRJ Times):

Columns	Variable	Entry
1-5	K	Number of restraint joint
6-10	RL(2*K-1)	1 - If restrained in the Y direction 0 - If not restrained in the Y direction
11-15	RL(2*K)	1 - If rotational restraint exists in the Z axis 0 - If no rotational restraint exists in the Z axis

Continuous Beam Load Control - Line Type H:

Columns	Variable	Entry
1-5	NLJ	Number of loaded joints
6-10	NLM	Number of loaded members

Continuous Beam Joint Load Table - Line Type I (Repeated NLJ Times):

Columns	Variable	Entry
1-5	K	Number of joint which is loaded
6-15	A(2*K-1)	Value of the force applied at the joint in the Y direction
16-25	A(2*K)	Value of the couple applied at the joint in the Z direction

Continuous Beam Member Fixed End Actions - Line Type J (Repeated NLM Times):

Columns	Variable	Entry
1-5	I	Number of member which is loaded
6-15	AML(I,1)	Y force at the I end of the member
16-25	AML(I,2)	Z moment at the I end of the member
26-35	AML(I,3)	Y force at the J end of the member
36-45	AML(I,4)	Z moment at the J end of the member

Plane Truss Data. The plan truss data includes Line Types A and B plus the following lines.

Plane Truss Problem Control - Line Type C:

Columns	Variable	Entry
1-5	NM	Number of members
6-10	NJ	Number of joints
11-15	NR	Number of support restraints (total number of support reactions)
16-20	NRJ	Number of restrained joints (total number of supports)
21-30	E	Modulus of elasticity (for all members)

Plane Truss Joint Coordinate Table - Line Type D (Repeated NJ times):

Columns	Variable	Entry
1-5	J	Joint number
6-15	X(J)	X coordinate of joint
16-25	Y(J)	Y coordinate of joint

Plane Truss Member Table - Line Type E (Repeated NM times):

Columns	Variable	Entry
1-5	I	Member number
6-10	JJ(I)	Joint number for I end of member
11-15	JK(I)	Joint number for J end of member
16-25	AX(I)	Cross sectional area of the member

Line Type F (omitted)

Plane Truss Joint Restraints Table - Line Type G (Repeated NRJ times):

Columns	Variable	Entry
1-5	K	Number of restraint joint
6-10	RL(2*K-1)	0 - If not restrained in the X direction 1 - If restrained in the X direction
11-15	RL(2*K)	0 - If not restrained in the Y direction 1 - If restrained in the Y direction

Plane Truss Load Description - Line Type H:

Columns	Variable	Entry
1-5	NLJ	Number of joints which are loaded
6-10	NLM	Number of loaded members

Plane Truss Joint Load Table - Line Type I (Repeated NLJ times):

Columns	Variable	Entry
1-5	K	Number of joint which is loaded
6-15	A(2*K-1)	Value of load applied at the joint in the X direction
16-25	A(2*K)	Value of load applied at the joint in the Y direction

Plane Truss Member Load Table - Line Type J (Repeated NLM times):

Columns	Variable	Entry
1-5	I	Number of member which is loaded
6-15	AML(I,1)	X force at the I end of the member
16-25	AML(I,2)	Y force at the I end of the member
26-35	AML(I,3)	X force at the J end of the member
36-45	AML(I,4)	Y force at the J end of the member

Plane Frame Data. The plane frame data includes Line Types A and B plus the following lines.

Plane Frame Description - Line Type C:

Columns	Variable	Entry
1-5	NM	Number of members
6-10	NJ	Number of joints
11-15	NR	Number of support restraints (total number of support reactions)
16-20	NRJ	Number of restrained joints (total number of supports)
21-30	E	Modulus of elasticity (for all members)

Plane Frame Joint Coordinate Table - Line Type D (Repeated NJ times):

Columns	Variable	Entry
1-5	J	*Joint number*
6-15	X(J)	X coordinate of joint
16-25	Y(J)	Y coordinate of joint

Plane Frame Member Table - Line Type E (Repeated NM times):

Columns	Variable	Entry
1-5	I	Member number
6-10	JJ(I)	Joint number for I end of member
11-15	JK(I)	Joint number for J end of member
16-25	AX(I)	Cross sectional area of the member
26-35	IZ(I)	Moment of inertia about the Z axis

Line Type F (omitted)

Plane Frame Joint Restraint Table - Line Type G (Repeated NRJ times):

Columns	Variable	Entry
1-5	K	Number of restraint joint
6-10	RL(3*K-2)	0 - If not restrained in the X direction 1 - If restrained in the X direction
11-15	RL(3*K-1)	0 - If not restrained in the Y direction 1 - If restrained in the Y direction
16-20	RL(3*K)	0 - If no rotational restraint exists in the Z axis 1 - If rotational restraint exists in the Z axis

Plane Frame Load Description - Line Type H:

Columns	Variable	Entry
1-5	NLJ	Number of loaded joints
6-10	NLM	Number of loaded members

Plane Frame Joint Load Table - Line Type I (Repeated NLJ times):

Columns	Variable	Entry
1-5	I	Number of joint which is loaded
6-15	A(3*K-2)	Value of load applied at the joint in the X direction
16-25	A(3*K-1)	Value of load applied at the joint in the Y direction
26-35	A(3*K)	Value of couple applied at the joint in the Z direction

Plane Frame Member Fixed End Actions - Line Type J (Repeated NLM Times):

Columns	Variable	Entry
1-5	I	Number of member which is loaded
6-15	AML(I,1)	X force at the I end of the member
16-25	AML(I,2)	Y force at the I end of the member
26-35	AML(I,3)	Z moment at the I end of the member
36-45	AML(I,4)	X force at the J end of the member
46-55	AML(I,5)	Y force at the J end of the member
56-65	AML(I,6)	Z moment at the J end of the member

Grid Frame Data. The grid frame data included Line Types A and B plus the following lines.

Grid Frame Description - Line Type C:

Columns	Variable	Entry
1-5	NM	Number of members
6-10	NJ	Number of joints
11-15	NR	Number of support restraints (total number of support reactions)
16-20	NRJ	Number of restrained joints (total number of supports)
21-30	E	Modulus of elasticity (for all members)
31-40	G	Modulus of elasticity for shear

Grid Frame Joint Coordinate Table - Line Type D (Repeated NJ times):

Columns	Variable	Entry
1-5	J	Joint number
6-15	X(J)	X coordinate of joint
16-25	Y(J)	Y coordinate of joint

Grid Frame Member Table - Line Type E (Repeated NM times):

Columns	Variable	Entry
1-5	I	Member number
6-10	JJ(I)	Joint number for I end of member
11-15	JK(I)	Joint number for J end of member
16-25	IX(I)	Torsion constant of member
26-35	IY(I)	Moment of inertia about the Y axis

Line Type F (omitted)

Grid Frame Joint Restraint Table - Line Type G (Repeated NRJ times):

Columns	Variable	Entry
1-5	K	Number of restraint joint
6-10	RL(3*K-2)	0 - If no rotational restraint exists in the X axis 1 - If rotational restraint exists in the X axis
11-15	RL(3*K-1)	0 - If no rotational restraint exists in the Y axis 1 - If rotational restraint exists in the Y axis
16-20	RL(3*K)	0 - If not restrained in the Z direction 1 - If restrained in the Z direction

Grid Frame Load Control - Line Type H:

Columns	Variable	Entry
1-5	NLJ	Number of loaded joints
6-10	NLM	Number of loaded members

Grid Frame Joint Load Table - Line Type I (Repeated NLJ times):

Columns	Variable	Entry
1-5	K	Number of joint which is loaded
6-15	A(3*K-2)	Value of the moment applied in the X direction
16-25	A(3*K-1)	Value of the moment applied in the Y direction
26-35	A(3*K)	Value of the load applied in the Z direction

Grid Frame Member Fixed End Actions - Line Type J (Repeated NLM Times):

Columns	Variable	Entry
1-5	I	Number of member which is loaded
6-15	AML(I,1)	X moment at the I end of the member
16-25	AML(I,2)	Y moment at the I end of the member
26-35	AML(I,3)	Z force at the I end of the member
36-45	AML(I,4)	X moment at the J end of the member
46-55	AML(I,5)	Y moment at the J end of the member
56-65	AML(I,6)	Z force at the J end of the member

Space Truss Data. The space truss data includes Line Types A and B plus the following lines.

Space Truss Problem Control - Line Type C:

Columns	Variable	Entry
1-5	NM	Number of members
6-10	NJ	Number of joints
11-15	NR	Number of support restraints (total number of support reactions)
16-20	NRJ	Number of restrained joints (total number of supports)
21-30	E	Modulus of elasticity (for all members)

Space Truss Joint Coordinate Table - Line Type D (Repeated NJ times):

Columns	Variable	Entry
1-5	J	Joint number
6-15	X(J)	X coordinate of joint
16-25	Y(J)	Y coordinate of joint
26-35	Z(J)	Z coordinate of joint

Space Truss Member Table - Line Type E (Repeated NM times):

Columns	Variable	Entry
1-5	I	Member number
6-10	JJ(I)	Joint number for I end of member
11-15	JK(I)	Joint number for J end of member
16-25	AX(I)	Cross sectional area of the member

Line Type F (omitted)

Space Truss Joint Restraint Table - Line Type G (Repeated NRJ times):

Columns	Variable	Entry
1-5	K	Number of restraint joint
6-10	RL(3*K-2)	0 - If not restrained in the X direction 1 - If restrained in the X direction
11-15	RL(3*K-1)	0 - If not restrained in the Y direction 1 - If restrained in the Y direction
16-20	RL(3*K)	0 - If not restrained in the Z direction 1 - If restrained in the Z direction

Space Truss Load Control - Line Type H:

Columns	Variable	Entry
1-5	NLJ	Number of loaded joints
6-10	NLM	Number of loaded members

Space Truss Joint Load Table - Line Type I (Repeated NLJ times):

Columns	Variable	Entry
1-5	K	Number of joint which is loaded
6-15	A(3*K-2)	Value of the load applied in the X direction
16-25	A(3*K-1)	Value of the load applied in the Y direction
26-35	A(3*K)	Value of the load applied in the Z direction

Space Truss Member Fixed End Action - Line Type J (Repeated NLM Times):

Columns	Variable	Entry
1-5	I	Number of member which is loaded
6-15	AML(I,1)	X force at the I end of the member
16-25	AML(I,2)	Y force at the I end of the member
26-35	AML(I,3)	Z force at the I end of the member
36-45	AML(I,4)	X force at the J end of the member
46-55	AML(I,5)	Y force at the J end of the member
56-65	AML(I,6)	Z force at the J end of the member

Space Frame Data. The frame data includes Line Types A and B plus the following lines:

Space Frame Control - Line Type C:

Columns	Variable	Entry
1-5	NM	Number of members
6-10	NJ	Number of joints
11-15	NR	Number of support restraints (total number of support reactions)
16-20	NRJ	Number of restrained joints (total number of supports)
21-30	E	Modulus of elasticity (for all members)
31-40	G	Modulus of elasticity for shear

Space Frame Joint Coordinate Table - Line Type D (Repeated NJ times):

Columns	Variable	Entry
1-5	J	Joint number
6-15	X(J)	X coordinate of joint
16-25	Y(J)	Y coordinate of joint
26-35	Z(J)	Z coordinate of joint

Space Frame Member Table - Line Type E (Repeated NM times):

Columns	Variable	Entry
1-5	I	Member number
6-10	JJ(I)	Joint number for I end of member
11-15	JK(I)	Joint number for J end of member
16-25	AX(I)	Cross sectional area of the member
26-35	IX(I)	Torsion constant of member
36-45	1Y(I)	Moment of inertia about the Y axis
46-55	1Z(I)	Moment of inertia about the Z axis

Columns	Variable	Entry
56-60	AA	Rotation of member about its x axis 0 - No rotation 1 - Rotation defined on line type E2

Space Frame Member Rotation Table - Line Type F:

Columns	Variable	Entry
1-5	I	Member number
6-15	XP	X coordinate defined in the structure axis system of a point "P" located in the principle X-Y plane of the member
16-25	YP	Y coordinate of point "P"
26-35	ZP	Z coordinate of point "P"

Space Frame Joint Restraint Table - Line Type G (Repeated NRJ times):

Columns	Variable	Entry
1-5	K	Number of restraint joint
6-10	RL(6*K-5)	1 - If restraint in the X direction 0 - If no restraint in the X direction
11-15	RL(6*K-4)	1 - If restraint in the Y direction 0 - If no restraint in the Y direction
16-20	RL(6*K-3)	1 - If restraint in the Z direction 0 - If no restraint in the Z direction
21-25	RL(6*K-2)	1 - If rotational restraint in the X axis 0 - If no rotational restraint in the X axis
26-30	RL(6*K-1)	1 - If rotational restraint in the Y axis 0 - If no rotational restraint in the Y axis

Columns	Variable	Entry
31-35	RL(6*K)	1 - If rotational restraint in the Z axis 0 - If no rotational restraint in the Z axis

Space Frame Load Control - Line Type H:

Columns	Variable	Entry
1-5	NLJ	Number of loaded joints
6-10	NLM	Number of loaded members

Space Frame Joint Load Tables - Line Type I (Repeated NLJ times):

Columns	Variable	Entry
1-5	K	Number of joint which is loaded
6-15	A(6*K-5)	Value of the load applied in the X direction
16-25	A(6*K-4)	Value of the load applied in the Y direction
26-35	A(6*K-3)	Value of the load applied in the Z direction
36-45	A(6*K-2)	Value of the couple applied in the X direction
46-55	A(6*K-1)	Value of the couple applied in the Y direction
56-65	A(6*K)	Value of the couple applied in the Z direction

Space Frame Member Fixed End Actions (Repeated NLM Times):

Fixed End Actions Located At The I End - Line Type J

Columns	Variable	Entry
1-5	I	Member identification number
6-15	AML(I,1)	X force
16-25	AML(I,2)	Y force
26-35	AML(I,3)	Z force

Columns	Variable	Entry
36-45	AML(I,4)	X moment
46-55	AML(I,5)	Y moment
56-65	AML(I,6)	Z moment

Fixed End Actions Located At The J End - Line Type K

Columns	Variable	Entry
6-15	AML(I,7)	X force
16-25	AML(I,8)	Y force
26-35	AML(I,9)	Z force
36-45	AML(I,10)	X moment
46-55	AML(I,11)	Y moment
56-65	AML(I,12)	Z moment

EXECUTION INSTRUCTIONS

The program is designed to run on an IBM PC compatible personal computer having at least 512K memory and a math coprocessor. There are a number of ways to execute the program and each will be discussed.

Installation

The S7001 program is provided on a single diskette. The diskette contains:

S7001.EXE	The executable program
WCBEAM.DAT	Continuous beam example problem
MMTRUSS.DAT	Plane truss sample problem
W2FRAME2.DAT	Plane frame sample problem
W2GRID1.DAT	Grid frame sample problem
W3TRUSS1.DAT	Space truss sample problem
W3FRAME2.DAT	Space frame sample problem
RUNS7001.BAT	The batch execute file
RMFORT.ERR	The execution error message file

These files should be copied to the hard disk or to another floppy disk before the program is used. The standard DOS COPY Command can be used:

```
COPY A:*.* C:  For the hard disk
COPY A:*.* B:  For the floppy disk
```

The program is now ready to run using one of the methods described below.

Standard Execution

The standard way of executing the program involves preparing an input file and running the program with the print output going to a file. The program assumes the input data is contained in the file S7001.DAT. The data can be prepared using any line or screen editor program, such as the DOS EDLIN editor. Since the data file is in fixed (columnar) format, the use of a right-hand tab is recommended. The data file that is produced by the editor must be an ASCII file without special control characters. The user should prepare this file using the S7001.DAT file name, or the input can be prepared using any file name and copying the prepared file to S7001.DAT by using the standard DOS COPY Command. The program will write the print output to S7001.OUT. The S7001.OUT file can be printed using the standard DOS PRINT Command. The program, S7001.EXE, is executed by typing S7001.

Output Redirection

The user can use the DOS SET Command to redirect the output. The default input and output file names can be changed by:

```
SET S7001.DAT= your input file name
SET S7001.OUT= your output file name
```

Then the program can be run by the S7001 command. CAUTION! The DOS redirection mechanism is active for the duration of the run of the program. The SET Command stays set until the connection is broken in the following manner or through a system reboot:

```
SET S7001.DAT=
SET S7001.OUT=
```

Batch File Execution

The program can be run with a batch file. For example, the batch file might be called RUNS7001.BAT, and it would contain:

```
SET S7001.DAT=%1
SET S7001.OUT=LPT1
S7001
SET S7001.DAT=
SET S7001.OUT=
```

The program would then be executed by the command:

```
RUNS7001 <your data file name>.
```

ACKNOWLEDGMENT

Appreciation is expressed to Frank E. Eby and John Cecilio who wrote the original program and user manual. They also installed this program on the time sharing service bureau computers used by the Naval Facilities Engineering Command. Troy E. Gillum and Steve M. Davis prepared and validated the test problems.

REFERENCE

1. W. Weaver, Jr. Computer programs for structural analysis. Princeton, N.J., D. Van Nostrand Company, 1967.

Appendix A

CONTINUOUS BEAM SAMPLE PROBLEM

CONTINUOUS BEAM PROBLEM DEFINITION

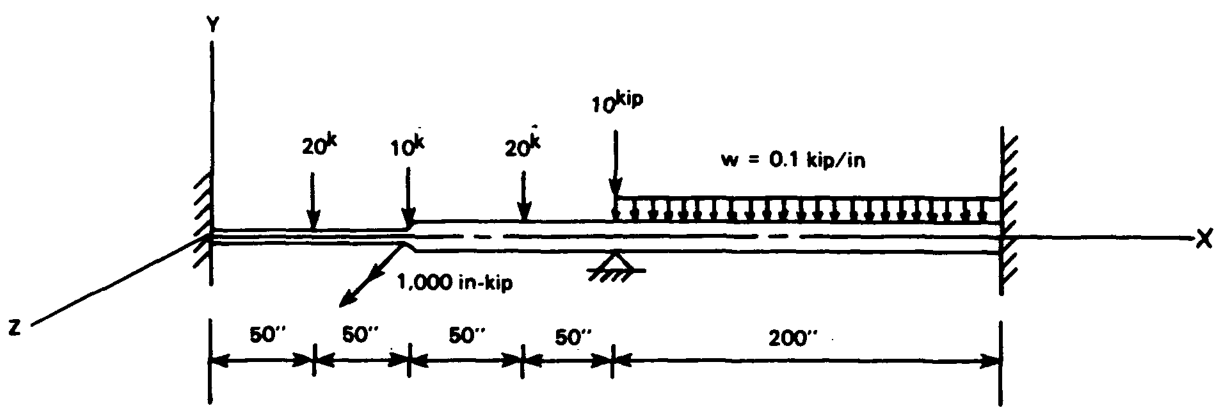
The intent of this sample problem is to demonstrate the continuous beam features of S7001. Furthermore, the problem demonstrates how to handle loads applied along the length of a member and at joints. Consistent engineering units are employed so the results are in terms of inches and kips.

Section properties:

Area	N/A
Major moment of inertia	1000.0 $in.^4$
Minor moment of inertia	N/A
Torsion constant	N/A

Material properties:

Modulus of elasticity	10000.0 ksi
Shear modulus	N/A
Unit weight	0.0 lb/ft^3



Weaver Continuous Beam Example 3*

*Weaver, William, Jr., "Computer Programs for Structural Analysis," D. Van Nostrand Company, Inc., Princeton, NJ, 1967, pp 127, and 135.

Calculation of equivalent fixed end loads:

1. Fix both ends of member.

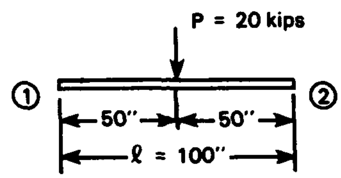
2. Calculate fixed end moments and shears using appropriate formula.

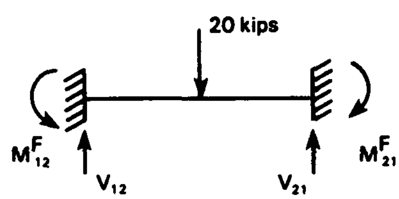
Example - Fixed end actions on continuous beam

<u>Member 1</u>

$$M^F_{12} = -M^F_{21} = \frac{P\ell}{8} = \frac{(20.0)(100.0)}{8} = 250.0 \text{ in-kips}$$

$$V_{12} = V_{12} = \frac{P}{2} = \frac{(20.0)}{2} = 10.0 \text{ kips}$$

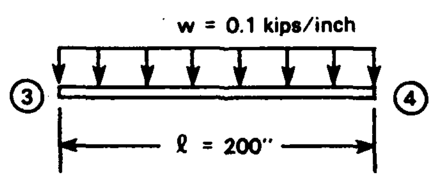


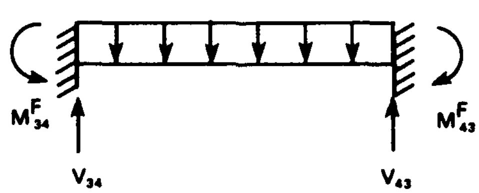


<u>Member 3</u>

$$M^F = -M_{43} = \frac{W\ell^2}{12} - \frac{(0.1)(200.0)^2}{12} = 333.33 \text{ in-kips}$$

$$V_{34} = V_{43} = \frac{W\ell}{2} = \frac{(0.1)(200.0)}{2} = 10.0 \text{ kips}$$





DATA INPUT FILE

```
      |                                     COLUMN
LINE  |          1         2         3         4         5         6         7         8
TYPE  | 12345678901234567890123456789012345678901234567890123456789012345678901234567890
------+---------------------------------------------------------------------------------
A     | WEAVER, CONTINUOUS BEAM EXAMPLE, PAGE 127 AND 135
B     |     1    1
C     |     3    5    3  10000.00
E-1   |     1    100.00   1000.00
E-2   |     2    100.00   2000.00
E-3   |     3    200.00   2000.00
G-1   |     1    1    1
G-2   |     3    1    0
G-3   |     4    1    1
H     |     2    3
I-1   |     2    -10.00   1000.00
I-2   |     3    -10.00      0.00
J-1   |     1     10.00    250.00     10.00   -250.00
J-2   |     2     10.00    250.00     10.00   -250.00
J-3   |     3     10.00    333.33     10.00   -333.33
```

PRINTED OUTPUT

WEAVER, CONTINUOUS BEAM EXAMPLE, PAGE 127 AND 135

CONTINUOUS BEAM ANALYSIS

```
NUMBER OF MEMBERS              =         3
NUMBER OF DEGREES OF FREEDOM   =         3
NUMBER OF JOINTS               =         4
NUMBER OF SUPPORT RESTRAINTS   =         5
NUMBER OF RESTRAINED JOINTS    =         3
MODULUS OF ELASTICITY (E)      =  10000.00
NUMBER OF LOADING SYSTEMS      =         1
```

MEMBER INFORMATION

MEMBER	START	END	IZ	L
1	1	2	1000.00	100.00
2	2	3	2000.00	100.00
3	3	4	2000.00	200.00

JOINT RESTRAINTS

JOINT	Y-TRANS	Z-ROT
1	1	1
3	1	0
4	1	1

PRINTED OUTPUT

LOAD SET NUMBER 1
NUMBER OF LOADED JOINTS = 2
NUMBER OF LOADED MEMBERS = 3

ACTIONS APPLIED AT JOINTS

JOINT	Y-FORCE	Z-MOMENT
2	-10.000	1000.000
3	-10.000	0.000

MEMBER END ACTIONS DUE TO MEMBER LOADS

	I-END		J-END	
MEMBER	Y-FORCE	Z-MOMENT	Y-FORCE	Z-MOMENT
1	10.00	250.00	10.00	-250.00
2	10.00	250.00	10.00	-250.00
3	10.00	333.33	10.00	-333.33

JOINT DISPLACEMENTS

JOINT	Y-TRANS	Z-ROT
1	0.000	0.000
2	-0.132	0.001
3	0.000	0.001
4	0.000	0.000

MEMBER END-ACTIONS

	I-END		J-END	
MEMBER	Y-FORCE	Z-MOMENT	Y-FORCE	Z-MOMENT
1	33.06	1281.75	-13.06	1023.81
2	3.06	-23.81	16.94	-670.63
3	12.53	670.63	7.47	-164.68

SUPPORT REACTIONS

JOINT	Y-REACTION	Z-MOMENT
1	33.06	1281.75
3	39.47	0.00
4	7.47	-164.68

Appendix B

PLANE TRUSS SAMPLE PROBLEM

PLANE TRUSS PROBLEM DEFINITION

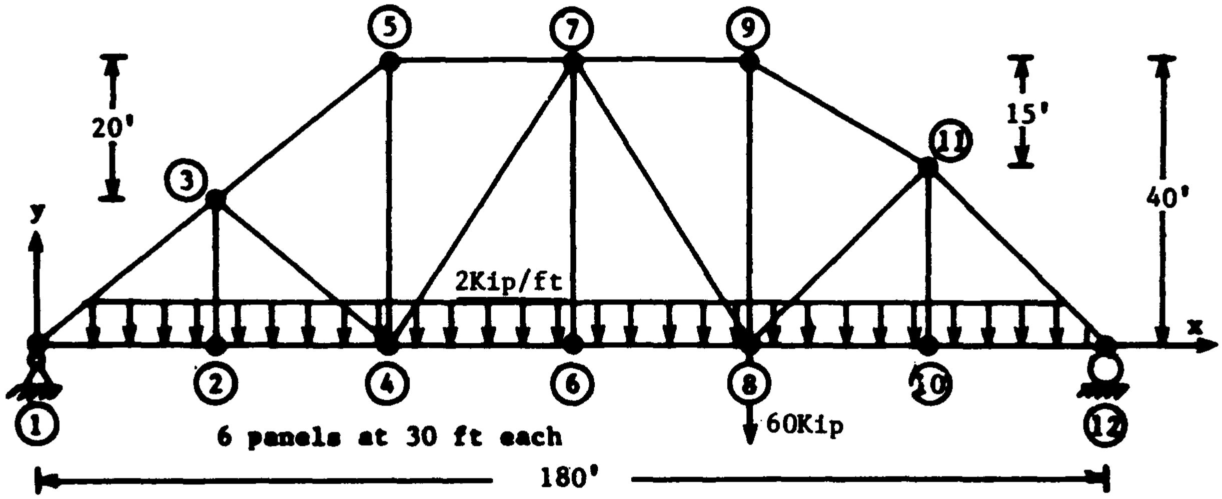
The intent of this sample problem is to demonstrate the plane truss features of S7001. Furthermore, the problem demonstrates how to handle uniform distributed loads in a truss system. Consistent engineering units are used so the problem is solved in terms of feet and kips.

Section Properties:

Area	20.59 $in.^2$
Major moment of inertia	N/A
Minor moment of inertia	N/A
Torsion constant	N/A

Material Properties:

Modulus of Elasticity	29,000,000 $lb/in.^2$
Shear modulus	N/A
Unit weight	490 lb/ft^3



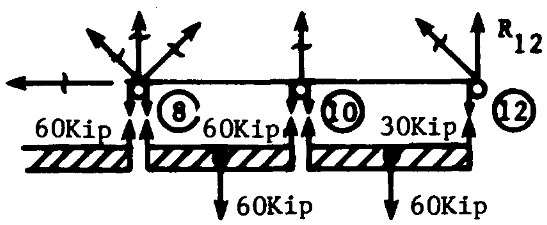
Mantell and Marron example 3-9 and 3-15*

---

*Mantell, M.I., and Marron, J.F., "Structural Analysis," The Ronald Press Company, New York, NY, 1962, pages 84, 92, 93.

Uniform distributed loads:

Uniform distributed loads can not be applied to a truss member because analysis theory does not permit a truss member to support bending. Therefore, such loads are usually applied through collector beams, simply supported by truss joints. In this problem, the uniform load (Kip/ft^2) covering the bridge deck has been converted to a uniform line load (2 Kip/ft^2) by considering an appropriate tributary area width. The interior joints receive a full panel load and each end joint receives a half panel load as shown below:



DATA INPUT FILE

```
                                            COLUMN
LINE             1         2         3         4         5         6         7         8
TYPE    12345678901234567890123456789012345678901234567890123456789012345678901234567890

A       PLANE TRUSS: MANTELL AND MARRON PAGE 84 EXAMPLE 3-9
B           2    1
C          21   12    3    2  4176000.
D-1         1       0.0       0.0
D-2         2      30.0       0.0
D-3         3      30.0      20.0
D-4         4      60.0       0.0
D-5         5      60.0      40.0
D-6         6      90.0       0.0
D-7         7      90.0      40.0
D-8         8     120.0       0.0
D-9         9     120.0      40.0
D-10       10     150.0       0.0
D-11       11     150.0      25.0
D-12       12     180.0       0.0
E-1         1    1    2     0.143
E-2         2    1    3     0.143
E-3         3    2    3     0.143
E-4         4    2    4     0.143
E-5         5    3    4     0.143
E-6         6    3    5     0.143
E-7         7    4    5     0.143
E-8         8    4    6     0.143
E-9         9    4    7     0.143
E-10       10    5    7     0.143
E-11       11    6    7     0.143
E-12       12    6    8     0.143
E-13       13    7    8     0.143
E-14       14    7    9     0.143
E-15       15    8    9     0.143
E-16       16    8   10     0.143
E-17       17    8   11     0.143
E-17       18    9   11     0.143
E-19       19   10   11     0.143
E-20       20   10   12     0.143
E-21       21   11   12     0.143
G-1         1    1    1
G-2        12    0    1
H           7    0
I-1         1       0.0     -30.0
I-2         2       0.0     -60.0
I-3         4       0.0     -60.0
I-4         6       0.0     -60.0
I-5         8       0.0    -120.0
I-6        10       0.0     -60.0
I-7        12       0.0     -30.0
```

PRINTED OUTPUT

PLANE TRUSS: MANTELL AND MARRON PAGE 84 EXAMPLE 3-9

PLANE TRUSS ANALYSIS

NUMBER OF MEMBERS	=	21
NUMBER OF DEGREES OF FREEDOM	=	21
NUMBER OF JOINTS	=	12
NUMBER OF SUPPORT RESTRAINTS	=	3
NUMBER OF RESTRAINED JOINTS	=	2
MODULUS OF ELASTICITY (E)	=	4176000.00
NUMBER OF LOADING SYSTEMS	=	1

JOINT COORDINATES

JOINT	X	Y
1	0.00	0.00
2	30.00	0.00
3	30.00	20.00
4	60.00	0.00
5	60.00	40.00
6	90.00	0.00
7	90.00	40.00
8	120.00	0.00
9	120.00	40.00
10	150.00	0.00
11	150.00	25.00
12	180.00	0.00

PRINTED OUTPUT

MEMBER INFORMATION

MEMBER	START	END	AREA	L
1	1	2	0.14	30.00
2	1	3	0.14	36.06
3	2	3	0.14	20.00
4	2	4	0.14	30.00
5	3	4	0.14	36.06
6	3	5	0.14	36.06
7	4	5	0.14	40.00
8	4	6	0.14	30.00
9	4	7	0.14	50.00
10	5	7	0.14	30.00
11	6	7	0.14	40.00
12	6	8	0.14	30.00
13	7	8	0.14	50.00
14	7	9	0.14	30.00
15	8	9	0.14	40.00
16	8	10	0.14	30.00
17	8	11	0.14	39.05
18	9	11	0.14	33.54
19	10	11	0.14	25.00
20	10	12	0.14	30.00
21	11	12	0.14	39.05

JOINT RESTRAINTS

JOINT	X-TRANS	Y-TRANS
1	1	1
12	0	1

PRINTED OUTPUT

LOAD SET NUMBER 1
NUMBER OF LOADED JOINTS = 7
NUMBER OF LOADED MEMBERS = 0

ACTIONS APPLIED AT JOINTS

JOINT	X-FORCE	Y-FORCE
1	0.000	-30.000
2	0.000	-60.000
4	0.000	-60.000
6	0.000	-60.000
8	0.000	-120.000
10	0.000	-60.000
12	0.000	-30.000

JOINT DISPLACEMENTS

JOINT	X-TRANS	Y-TRANS
1	0.000	0.000
2	0.013	-0.109
3	0.049	-0.107
4	0.026	-0.136
5	0.044	-0.126
6	0.038	-0.152
7	0.033	-0.148
8	0.050	-0.134
9	0.021	-0.126
10	0.062	-0.097
11	0.020	-0.095
12	0.073	0.000

PRINTED OUTPUT

MEMBER END-ACTIONS

	I-END		J-END	
MEMBER	X-FORCE	Y-FORCE	X-FORCE	Y-FORCE
1	-255.00	0.00	255.00	0.00
2	306.47	0.00	-306.47	0.00
3	-60.00	0.00	60.00	0.00
4	-255.00	0.00	255.00	0.00
5	54.08	0.00	-54.08	0.00
6	252.39	0.00	-252.39	0.00
7	-140.00	0.00	140.00	0.00
8	-247.50	0.00	247.50	0.00
9	62.50	0.00	-62.50	0.00
10	210.00	0.00	-210.00	0.00
11	-60.00	0.00	60.00	0.00
12	-247.50	0.00	247.50	0.00
13	12.50	0.00	-12.50	0.00
14	240.00	0.00	-240.00	0.00
15	-120.00	0.00	120.00	0.00
16	-228.00	0.00	228.00	0.00
17	-15.62	0.00	15.62	0.00
18	268.33	0.00	-268.33	0.00
19	-60.00	0.00	60.00	0.00
20	-228.00	0.00	228.00	0.00
21	296.79	0.00	-296.79	0.00

SUPPORT REACTIONS

JOINT	X-REACTION	Y-REACTION
1	0.00	200.00
12	0.00	220.00

Appendix C

PLANE FRAME SAMPLE PROBLEM

PLANE FRAME PROBLEM DEFINITION

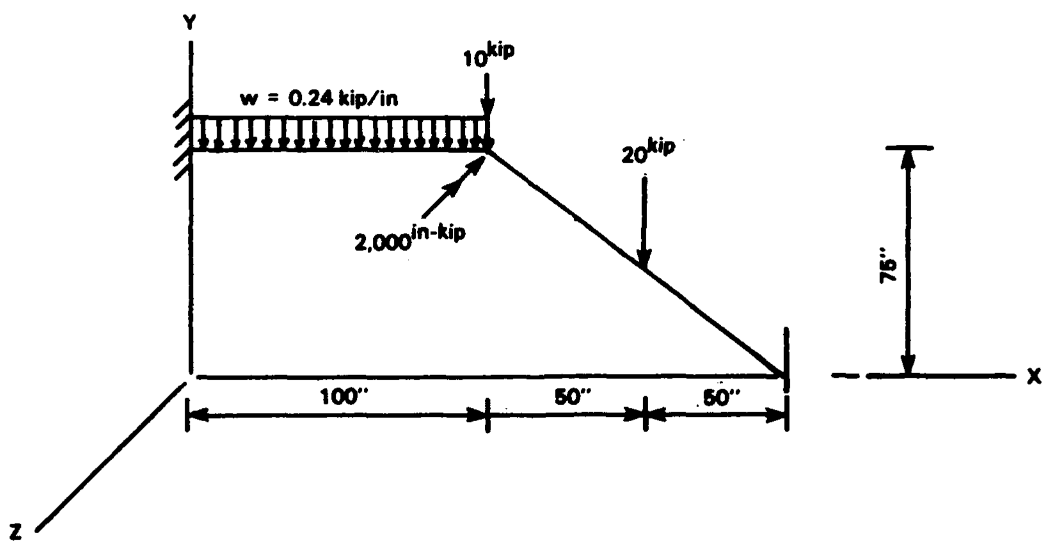
The intent of this sample problem is to demonstrate the plane frame features of S7001. Furthermore, the problem demonstrates how to handle loads applied along the length of a member and at joints. Consistent engineering units are employed so the results are in terms of inches and kips.

Section properties:

Area	10.0 $in.^2$
Major moment of inertia	1000.0 $in.^4$
Minor moment of inertia	N/A
Torsion constant	N/A

Material properties:

Modulus of elasticity	10000.0 Ksi
Shear modulus	N/A
Unit weight	0.0 lb/ft^3



Weaver Plane Frame Example 3*

*Weaver, William, Jr., "Computer Programs for Structural Analysis," D. Van Nostrand Company, Inc., Princeton, NJ, 1967, pp 129, 134, 138, 139.

DATA INPUT FILE

```
LINE |                                  COLUMN
LINE |         1         2         3         4         5         6         7         8
TYPE |12345678901234567890123456789012345678901234567890123456789012345678901234567890
-----+--------------------------------------------------------------------------------
A    |PLANE FRAME: WEAVER PAGES 138, FIGURE 3-3 PAGE 129; 3 MEMBER APPROACH
B    |    3    1
C    |    3    4    6    2   10000.0
D-1  |    1       0.0      75.0
D-2  |    2     100.0      75.0
D-3  |    3     150.0      37.5
D-4  |    4     200.0       0.0
E-1  |    1    1    2      10.0    1000.0
E-2  |    2    2    3      10.0    1000.0
E-3  |    3    3    4      10.0    1000.0
G-1  |    1    1    1    1
G-2  |    4    1    1    1
H    |    2    1
I-1  |    2       0.0     -10.0   -1000.0
I-2  |    3       0.0     -20.0       0.0
J    |    1       0.0      12.0     200.0       0.0      12.0    -200.0
```

PRINTED OUTPUT

PLANE FRAME: WEAVER PAGES 138, FIGURE 3-3 PAGE 129; 3 MEMBER APPROACH

PLANE FRAME ANALYSIS

NUMBER OF MEMBERS	=	3
NUMBER OF DEGREES OF FREEDOM	=	6
NUMBER OF JOINTS	=	4
NUMBER OF SUPPORT RESTRAINTS	=	6
NUMBER OF RESTRAINED JOINTS	=	2
MODULUS OF ELASTICITY (E)	=	10000.00
NUMBER OF LOADING SYSTEMS	=	1

JOINT COORDINATES

JOINT	X	Y
1	0.00	75.00
2	100.00	75.00
3	150.00	37.50
4	200.00	0.00

MEMBER INFORMATION

MEMBER	START	END	AX	IZ	L
1	1	2	10.00	1000.00	100.00
2	2	3	10.00	1000.00	62.50
3	3	4	10.00	1000.00	62.50

JOINT RESTRAINTS

JOINT	X-TRANS	Y-TRANS	Z-ROT
1	1	1	1
4	1	1	1

PRINTED OUTPUT

LOAD SET NUMBER	1
NUMBER OF LOADED JOINTS =	2
NUMBER OF LOADED MEMBERS =	1

ACTIONS APPLIED AT JOINTS

JOINT	X-FORCE	Y-FORCE	Z-MOMENT
2	0.000	-10.000	-1000.000
3	0.000	-20.000	0.000

MEMBER END ACTIONS DUE TO MEMBER LOADS

		I-END			J-END	
MEMBER	X-FORCE	Y-FORCE	Z-MOMENT	X-FORCE	Y-FORCE	Z-MOMENT
1	0.00	12.00	200.00	0.00	12.00	-200.00

JOINT DISPLACEMENTS

JOINT	X-TRANS	Y-TRANS	Z-ROT
1	0.000	0.000	0.000
2	-0.020	-0.099	-0.002
3	-0.034	-0.087	0.002
4	0.000	0.000	0.000

MEMBER END-ACTIONS

		I-END			J-END	
MEMBER	X-FORCE	Y-FORCE	Z-MOMENT	X-FORCE	Y-FORCE	Z-MOMENT
1	20.26	13.14	436.65	-20.26	10.86	-322.87
2	28.73	-4.53	-677.13	-28.73	4.53	393.81
3	40.73	-20.53	-393.81	-40.73	20.53	-889.52

SUPPORT REACTIONS

JOINT	X-REACTION	Y-REACTION	Z-MOMENT
1	20.26	13.14	436.65
4	-20.26	40.86	-889.52

Appendix D

GRID FRAME SAMPLE PROBLEM

GRID FRAME PROBLEM DEFINITION

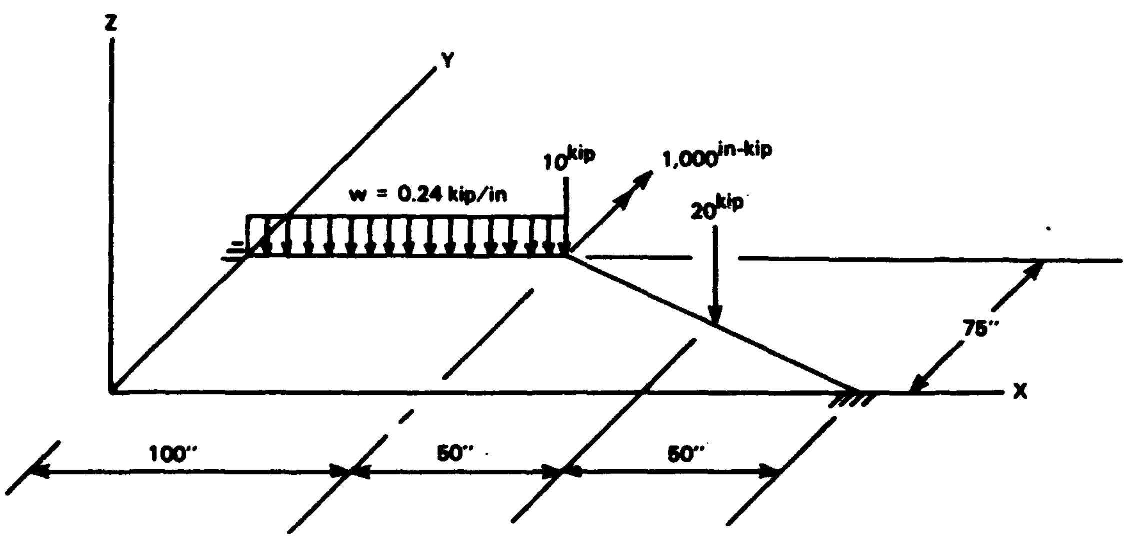
The intent of this sample problem is to demonstrate the grid frame features of S7001. Furthermore, the problem demonstrates how to handle loads applied along the length of a member and at joints. Consistent engineering units are employed so the results are in terms of inches and kips.

Section properties:

Area	10.0 $in.^2$
Major moment of inertia	1000.0 $in.^4$
Minor moment of inertia	1000.0 $in.^4$
Torsion constant	N/A

Material properties:

Modulus of elasticity	10000.0 Ksi
Shear modulus	4000.00 Ksi
Unit weight	0.0 lb/ft^3



Weaver Grid Frame Example 1

*Weaver, William, Jr., "Computer Programs for Structural Analysis," D. Van Nostrand Company, Inc., Princeton, NJ, 1967, pp 129, and 139.

DATA INPUT FILE

```
                                        COLUMN
LINE          1         2         3         4         5         6         7         8
TYPE 12345678901234567890123456789012345678901234567890123456789012345678901234567890

A    WEAVER, GRID EXAMPLE 1, PAGE 129 AND 139
B        4    1
C        2    3    6    2  10000.00   4000.00
D-1      1    100.00     75.00
D-2      2      0.00     75.00
D-3      3    200.00      0.00
E-1      1    2    1   1000.00   1000.00
E-2      2    1    3   1000.00   1000.00
G-1      2    1    1    1
G-2      3    1    1    1
H        1    2
I        1      0.00   1000.00    -10.00
J-1      1      0.00   -200.00     12.00      0.00    200.00     12.00
J-2      2      0.00   -312.50     10.00      0.00    312.50     10.00
```

PRINTED OUTPUT

WEAVER, GRID EXAMPLE 1, PAGE 129 AND 139

GRID FRAME ANALYSIS

NUMBER OF MEMBERS	=	2
NUMBER OF DEGREES OF FREEDOM	=	3
NUMBER OF JOINTS	=	3
NUMBER OF SUPPORT RESTRAINTS	=	6
NUMBER OF RESTRAINED JOINTS	=	2
MODULUS OF ELASTICITY (E)	=	10000.00
MODULUS OF ELASTICITY (G)	=	4000.00
NUMBER OF LOADING SYSTEMS	=	1

JOINT COORDINATES

JOINT	X	Y
1	100.00	75.00
2	0.00	75.00
3	200.00	0.00

MEMBER INFORMATION

MEMBER	START	END	IX	IY	L
1	2	1	1000.00	1000.00	100.00
2	1	3	1000.00	1000.00	125.00

JOINT RESTRAINTS

JOINT	X-ROT	Y-ROT	Y-TRANS
2	1	1	1
3	1	1	1

PRINTED OUTPUT

LOAD SET NUMBER 1
NUMBER OF LOADED JOINTS = 1
NUMBER OF LOADED MEMBERS = 2

ACTIONS APPLIED AT JOINTS

JOINT	X-MOMENT	Y-MOMENT	Z-FORCE
1	0.000	1000.000	-10.000

MEMBER END ACTIONS DUE TO MEMBER LOADS

	I-END			J-END		
MEMBER	X-MOMENT	Y-MOMENT	Z-FORCE	X-MOMENT	Y-MOMENT	Z-FORCE
1	0.00	-200.00	12.00	0.00	200.00	12.00
2	0.00	-312.50	10.00	0.00	312.50	10.00

JOINT DISPLACEMENTS

JOINT	X-ROT	Y-ROT	Z-TRANS
1	-0.008	0.005	-0.355
2	0.000	0.000	0.000
3	0.000	0.000	0.000

MEMBER END-ACTIONS

	I-END			J-END		
MEMBER	X-MOMENT	Y-MOMENT	Z-FORCE	X-MOMENT	Y-MOMENT	Z-FORCE
1	303.94	-1311.47	24.04	-303.94	107.50	-0.04
2	-292.34	896.36	-9.96	292.34	1598.68	29.96

SUPPORT REACTIONS

JOINT	X-MOMENT	Y-MOMENT	Z-REACTION
2	303.94	-1311.47	24.04
3	1193.08	1103.53	29.96

Appendix E

SPACE TRUSS SAMPLE PROBLEM

SPACE TRUSS PROBLEM DEFINITION

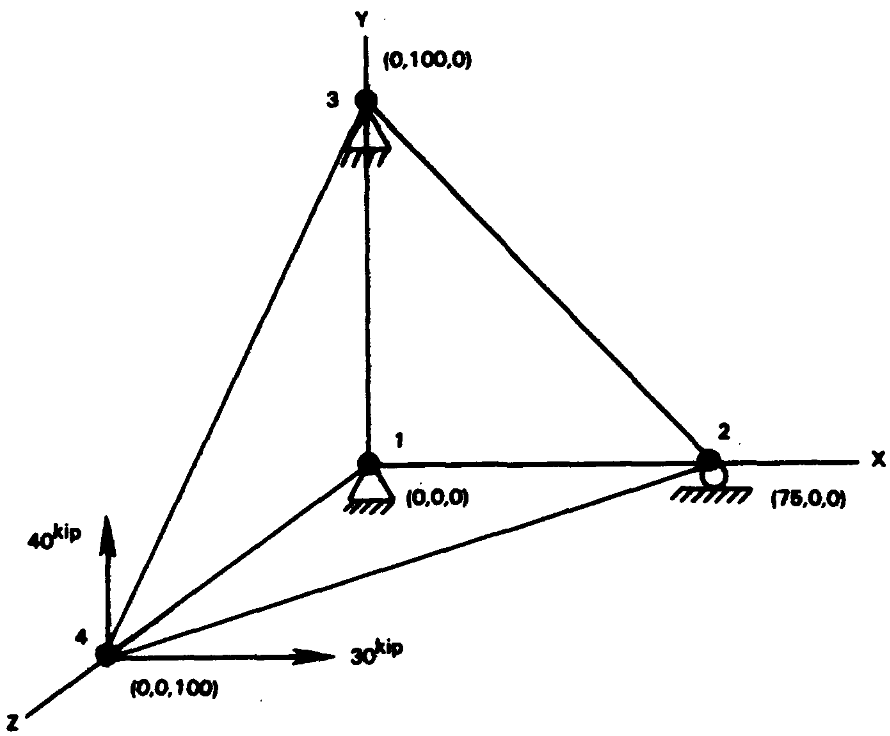
The intent of this sample problem is to demonstrate the space truss features of S7001. Furthermore, the problem demonstrates how to handle loads applied along the length of a member and at joints. Consistent engineering units are employed so the results are in terms of inches and kips.

Section properties:

Area	10.0 $in.^2$
Major moment of inertia	N/A
Minor moment of inertia	N/A
Torsion constant	N/A

Material properties:

Modulus of elasticity	10000.0 Ksi
Shear modulus	N/A
Unit weight	0.0 lb/ft^3



Weaver Space Truss Example 1

*Weaver, William, Jr., "Computer Programs for Structural Analysis," D. Van Nostrand Company, Inc., Princeton, NJ, 1967, pp 130, 142, and 143.

DATA INPUT FILE

```
          |                                     COLUMN
LINE      |         1         2         3         4         5         6         7         8
TYPE      |12345678901234567890123456789012345678901234567890123456789012345678901234567890
----------+--------------------------------------------------------------------------------
A         |WEAVER, SPACE TRUSS EXAMPLE 1, PAGE 130 AND 142-143
B         |    5    2
C         |    6    4    9    4    10000.
D-1       |    1       0.0       0.0       0.0
D-2       |    2      75.        0.0       0.0
D-3       |    3       0.0      100.       0.0
D-4       |    4       0.0       0.0      100.
E-1       |    1    1    2      10.
E-2       |    2    1    3      10.
E-3       |    3    1    4      10.
E-4       |    4    2    3      10.
E-5       |    5    2    4      10.
E-6       |    6    3    4      10.
G-1       |    1    1    1    1
G-2       |    2    0    1    1
G-3       |    3    1    1    1
G-4       |    4    0    0    1
H         |    1    0
I         |    4       30.       40.       0.0
H         |    0    2
J-1       |    2      -20.       20.      -10.      -20.       20.      -10.
J-2       |    5        5.       10.        5.        5.       10.        5.
```

PRINTED OUTPUT

WEAVER, SPACE TRUSS EXAMPLE 1, PAGE 130 AND 142-143

SPACE TRUSS ANALYSIS

NUMBER OF MEMBERS	=	6
NUMBER OF DEGREES OF FREEDOM	=	3
NUMBER OF JOINTS	=	4
NUMBER OF SUPPORT RESTRAINTS	=	9
NUMBER OF RESTRAINED JOINTS	=	4
MODULUS OF ELASTICITY (E)	=	10000.00
NUMBER OF LOADING SYSTEMS	=	2

JOINT COORDINATES

JOINT	X	Y	Z
1	0.00	0.00	0.00
2	75.00	0.00	0.00
3	0.00	100.00	0.00
4	0.00	0.00	100.00

MEMBER INFORMATION

MEMBER	START	END	AX	L
1	1	2	10.00	75.00
2	1	3	10.00	100.00
3	1	4	10.00	100.00
4	2	3	10.00	125.00
5	2	4	10.00	125.00
6	3	4	10.00	141.42

JOINT RESTRAINTS

JOINT	X-TRANS	Y-TRANS	Z-TRANS
1	1	1	1
2	0	1	1
3	1	1	1
4	0	0	1

PRINTED OUTPUT

LOAD SET NUMBER 1
NUMBER OF LOADED JOINTS = 1
NUMBER OF LOADED MEMBERS = 0

ACTIONS APPLIED AT JOINTS

JOINT	X-FORCE	Y-FORCE	Z-FORCE
4	30.000	40.000	0.000

JOINT DISPLACEMENTS

JOINT	X-DISP	Y-DISP	Z-DISP
1	0.000	0.000	0.000
2	0.019	0.000	0.000
3	0.000	0.000	0.000
4	0.123	0.113	0.000

MEMBER END-ACTIONS

	I-END			J-END		
MEMBER	X-FORCE	Y-FORCE	Z-FORCE	X-FORCE	Y-FORCE	Z-FORCE
1	-24.67	0.00	0.00	24.67	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00
4	-8.88	0.00	0.00	8.88	0.00	0.00
5	50.00	0.00	0.00	-50.00	0.00	0.00
6	56.57	0.00	0.00	-56.57	0.00	0.00

SUPPORT REACTIONS

JOINT	X-REACTION	Y-REACTION	Z-REACTION
1	-24.67	0.00	0.00
2	0.00	-7.11	40.00
3	-5.33	-32.89	40.00
4	0.00	0.00	-80.00

PRINTED OUTPUT

LOAD SET NUMBER 2
NUMBER OF LOADED JOINTS = 0
NUMBER OF LOADED MEMBERS = 2

MEMBER END ACTIONS DUE TO MEMBER LOADS

		I-END			J-END	
MEMBER	X-FORCE	Y-FORCE	Z-FORCE	Z-FORCE	Y-FORCE	Z-FORCE
2	-20.00	20.00	-10.00	-20.00	20.00	-10.00
5	5.00	10.00	5.00	5.00	10.00	5.00

JOINT DISPLACEMENTS

JOINT	X-DISP	Y-DISP	Z-DISP
1	0.000	0.000	0.000
2	0.009	0.000	0.000
3	0.000	0.000	0.000
4	0.033	-0.028	0.000

MEMBER END-ACTIONS

		I-END			J-END	
MEMBER	X-FORCE	Y-FORCE	Z-FORCE	X-FORCE	Y-FORCE	Z-FORCE
1	-11.51	0.00	0.00	11.51	0.00	0.00
2	-20.00	20.00	-10.00	-20.00	20.00	-10.00
3	0.00	0.00	0.00	0.00	0.00	0.00
4	-4.14	0.00	0.00	4.14	0.00	0.00
5	16.67	10.00	5.00	-6.67	10.00	5.00
6	-14.14	0.00	0.00	14.14	0.00	0.00

SUPPORT REACTIONS

JOINT	X-REACTION	Y-REACTION	Z-REACTION
1	-31.51	-20.00	-10.00
2	0.00	6.68	10.33
3	-22.49	-6.68	-20.00
4	0.00	0.00	1.67

Appendix F

SPACE FRAME SAMPLE PROBLEM

SPACE FRAME PROBLEM DEFINITION

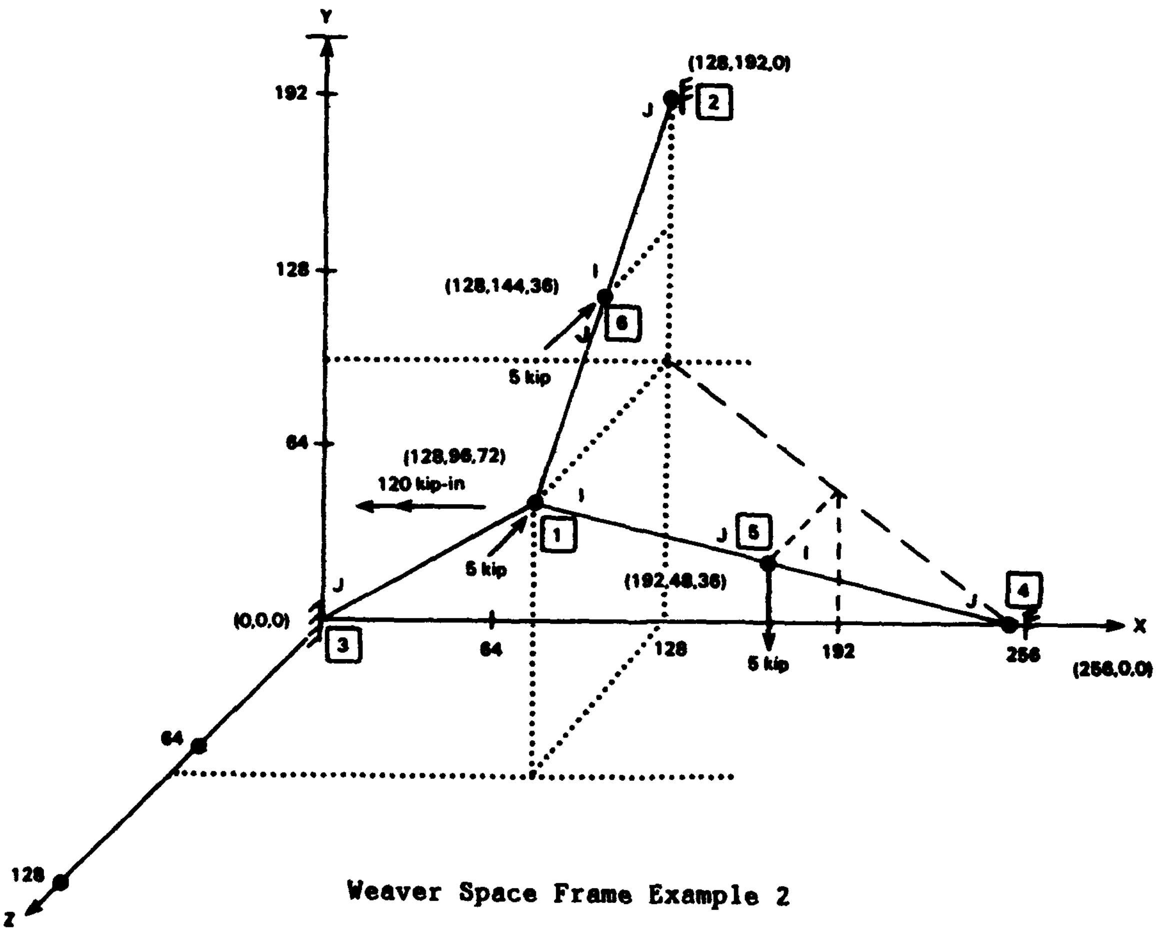
The intent of this sample problem is to demonstrate the space frame features of S7001. Consistent engineering units are used so the problem is solved in terms of inches and kips.

Section Properties:

Area	9.0 $in.^2$
Major moment of inertia	80.0 $in.^4$
Minor moment of inertia	28.0 $in.^4$
Torsion constant	64.0 $in.^4$

Material Properties:

Modulus of Elasticity	10,000,000 $lb/in.^2$
Shear modulus	4,000,000 $lb/in.^2$
Unit weight	0.0 $lb/in.^3$



Weaver Space Frame Example 2

---

*Weaver, William, Jr., "Computer Programs for Structural Analysis," D. Van Nostrand Company, Inc. Princton, N.J. 1967, pp 133, 134, 148, 149.

DATA INPUT FILE

```
LINE                                              COLUMN
TYPE           1         2         3         4         5         6         7         8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890

A     WEAVER, SPACE FRAME EXAMPLE 2, PAGE 133 AND 148-149
B         6    2
C         5    6   18    3   10000.0    4000.0
D-1       1     128.0      96.0      72.0
D-2       2     128.0     192.0       0.0
D-3       3       0.0       0.0       0.0
D-4       4     256.0       0.0       0.0
D-5       5     192.0      48.0      36.0
D-6       6     128.0     144.0      36.0
E-1       1    6    2       9.0      64.0      28.0      80.0   1
F-1       1     128.0      96.0       0.0
E-2       2    6    1       9.0      64.0      28.0      80.0   1
F-3       2     128.0      96.0       0.0
E-3       3    1    3       9.0      64.0      28.0      80.0   1
F-3       3     128.0      96.0       0.0
E-4       4    1    5       9.0      64.0      28.0      80.0   1
F-4       4     128.0      96.0       0.0
E-5       5    5    4       9.0      64.0      28.0      80.0   1
F-5       5     128.0      96.0       0.0
G-1       2    1    1    1    1    1    1
G-2       3    1    1    1    1    1    1
G-3       4    1    1    1    1    1    1
H-1       1    0
I-1       1       0.0       0.0      -5.0    -120.0       0.0       0.0
H-2       2    0
I-2       5       0.0      -5.0       0.0       0.0       0.0       0.0
I-3       6       0.0       0.0      -5.0       0.0       0.0       0.0
```

PRINTED OUTPUT

WEAVER, SPACE FRAME EXAMPLE 2, PAGE 133 AND 148-149

SPACE FRAME ANALYSIS

```
NUMBER OF MEMBERS              =          5
NUMBER OF DEGREES OF FREEDOM   =         18
NUMBER OF JOINTS               =          6
NUMBER OF SUPPORT RESTRAINTS   =         18
NUMBER OF RESTRAINED JOINTS    =          3
MODULUS OF ELASTICITY (E)      =   10000.00
MODULUS OF ELASTICITY (G)      =    4000.00
NUMBER OF LOADING SYSTEMS      =          2
```

JOINT COORDINATES

JOINT	X	Y	Z
1	128.00	96.00	72.00
2	128.00	192.00	0.00
3	0.00	0.00	0.00
4	256.00	0.00	0.00
5	192.00	48.00	36.00
6	128.00	144.00	36.00

MEMBER INFORMATION

```
MEMBER START END    AX      IX       IY       IZ    AA     L

  1      6    2   9.00   64.00    28.00    80.00   1   60.00
MEMBER AXIS ROTATION POINT: X =   128.00 Y =    96.00 Z =      0.00
  2      6    1   9.00   64.00    28.00    80.00   1   60.00
MEMBER AXIS ROTATION POINT: X =   128.00 Y =    96.00 Z =      0.00
  3      1    3   9.00   64.00    28.00    80.00   1  175.45
MEMBER AXIS ROTATION POINT: X =   128.00 Y =    96.00 Z =      0.00
  4      1    5   9.00   64.00    28.00    80.00   1   87.73
MEMBER AXIS ROTATION POINT: X =   128.00 Y =    96.00 Z =      0.00
  5      5    4   9.00   64.00    28.00    80.00   1   87.73
MEMBER AXIS ROTATION POINT: X =   128.00 Y =    96.00 Z =      0.00
```

PRINTED OUTPUT

JOINT RESTRAINTS

JOINT	X-TRANS	Y-TRANS	Z-TRANS	X-ROT	Y-ROT	Z-ROT
2	1	1	1	1	1	1
3	1	1	1	1	1	1
4	1	1	1	1	1	1

LOAD SET NUMBER 1
NUMBER OF LOADED JOINTS = 1
NUMBER OF LOADED MEMBERS = 0

ACTIONS APPLIED AT JOINTS

JOINT	X-FORCE	Y-FORCE	Z-FORCE	X-MOMENT	Y-MOMENT	Z-MOMENT
1	0.000	0.000	-5.000	-120.000	0.000	0.000

JOINT DISPLACEMENTS

JOINT	X-TRANS	Y-TRANS	Z-TRANS	X-ROT	Y-ROT	Z-ROT
1	0.000	-0.001	-0.011	-0.003	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	-0.025	0.028	0.000	0.001	0.001
6	0.000	-0.025	-0.039	0.001	0.000	0.000

MEMBER END-ACTIONS

MEMBER	END	X-FORCE	Y-FORCE	Z-FORCE	X-MOMENT	Y-MOMENT	Z-MOMENT
1	I	4.38	0.98	0.00	0.00	0.00	18.53
	J	-4.38	-0.98	0.00	0.00	0.00	40.08
2	I	4.38	-0.98	0.00	0.00	0.00	18.53
	J	-4.38	0.98	0.00	0.00	0.00	-77.14

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3	I	2.48	-0.24	0.05	2.96	-5.86	-28.92
	J	-2.48	0.24	-0.05	-2.96	-2.95	-13.71
4	I	2.48	-0.24	-0.05	-2.96	5.86	-28.92
	J	-2.48	0.24	0.05	2.96	-1.46	7.60
5	I	2.48	-0.24	-0.05	-2.96	1.46	-7.60
	J	-2.48	0.24	0.05	2.96	2.95	-13.71

SUPPORT REACTIONS

JOINT	X-REACTION	Y-REACTION	Z-REACTION	X-MOMENT	Y-MOMENT	Z-MOMENT
2	0.00	-2.91	3.41	-40.08	0.00	0.00
3	1.86	1.46	0.80	-7.03	11.86	3.90
4	-1.86	1.46	0.80	-7.03	-11.86	-3.90

LOAD SET NUMBER 2
NUMBER OF LOADED JOINTS = 2
NUMBER OF LOADED MEMBERS = 0

ACTIONS APPLIED AT JOINTS

JOINT	X-FORCE	Y-FORCE	Z-FORCE	X-MOMENT	Y-MOMENT	Z-MOMENT
5	0.000	-5.000	0.000	0.000	0.000	0.000
6	0.000	0.000	-5.000	0.000	0.000	0.000

JOINT DISPLACEMENTS

JOINT	X-TRANS	Y-TRANS	Z-TRANS	X-ROT	Y-ROT	Z-ROT
1	0.000	-0.003	-0.006	-0.002	0.000	-0.004
2	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000
5	-0.282	-0.428	0.062	0.001	0.000	0.001
6	0.052	-0.050	-0.069	0.001	0.002	0.000

PRINTED OUTPUT

MEMBER END-ACTIONS

MEMBER	END	X-FORCE	Y-FORCE	Z-FORCE	X-MOMENT	Y-MOMENT	Z-MOMENT
1	I	2.22	2.85	-0.41	6.07	8.13	76.15
	J	-2.22	-2.85	0.41	-6.07	16.23	94.56
2	I	-0.78	1.15	-0.41	6.07	-8.13	76.15
	J	0.78	-1.15	0.41	-6.07	32.49	-6.86
3	I	2.26	-0.24	-0.18	5.12	21.25	-28.53
	J	-2.26	0.24	0.18	-5.12	10.56	-13.91
4	I	0.73	0.42	1.73	-0.04	-56.04	3.95
	J	-0.73	-0.42	-1.73	0.04	-95.61	32.95
5	I	3.47	-0.81	-2.27	-0.04	95.61	-32.95
	J	-3.47	0.81	2.27	0.04	103.65	-38.16

SUPPORT REACTIONS

JOINT	X-REACTION	Y-REACTION	Z-REACTION	X-MOMENT	Y-MOMENT	Z-MOMENT
2	-0.41	-0.07	3.61	-94.56	-14.60	-9.34
3	1.84	1.15	0.71	-1.14	16.53	-7.52
4	-1.43	3.91	0.68	-56.89	-5.03	-94.53

S7001 - VERSION 1.0

FEEDBACK REPORT

The Naval Civil Engineering Laboratory is fully dedicated to supporting GEMS users. A primary requirement for this task is to establish a priority listing of user requirements. It would be of great value to the development of new software if you, the user, would complete the feedback questions below. Since each individual user may have specific requirements, please reproduce this page as many times as necessary.

Please circle the number that best applies in questions 1 through 4, complete the other questions, fold at tic marks, and mail to NCEL with franked label on reverse side or to address at bottom of page.

1. Was the software beneficial (productive)?

   No benefit 0 1 2 3 4 5 6 7 8 9 10 Very beneficial

2. Was it easy to use (user friendly)?

   Difficult 0 1 2 3 4 5 6 7 8 9 10 Very easy

3. Does this software make decisions more reliable?

   No 0 1 2 3 4 5 6 7 8 9 10 Yes

4. Does it better document the design?

   No 0 1 2 3 4 5 6 7 8 9 10 Yes

5. Did it save time?

   Yes____ No____ Estimated percent saved____

6. What would make future software more user friendly?

7. What further support would you like to have on the GEMS system?

8. What other comments or remarks would you like to add?

Activity____

Telephone____

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Naval Civil Engineering Laboratory
Code L54
Port Hueneme, CA 93043-5003

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